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BIOLOGICAL EVALUATION OF TIP MOTH INFESTATIONS OCCURRING AT SHAW AIR FORCE BASE, SOUTH CAROLINA 1982

by

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ABSTRACT

Tip moths (Rhyacionia spp.) are adversely affecting the growth and form of loblolly pines in a 550 acre pine plantation at Shaw Air Force Base, South Carolina. High population levels of these insects are currently present throughout the pine stands. Past agricultural use, poor planting techniques, and the off site planting of loblolly pine have contributed to the problem.

INTRODUCTION

Shaw Air Force Base is located in the central portion of South Carolina, 35 miles east of Columbia (figure 1). Before the acquisition of this property by the federal government in 1940, row crops were grown under intensive management. Between 1940 and 1974, the site was vegetated by native weeds and grasses that required frequent mowing. During the period 1975-1979, loblolly pine seedlings were machine planted until the present 550 acre plantation was established. The objectives in establishing the plantation were; (1) to eliminate this area from the need of frequent mowing, (2) to provide wind erosion control, (3) to plant vegetation that would eventually provide a noise abatement buffer from the nearby military airstrips, and (4) to provide revenues from a productive forest crop at some time in the future.

On February 16, 1982, the authors and Mr. Johnny Williamson (U.S. Fish and Wildlife Service) met with Mr. Bruce Ramo and M.Sgt. Lowell Lyman of Shaw Air Force Base to observe and discuss the tip moth problem. A later visit by William Carothers, Debra Allen (USDA Forest Service), Mr. Ramo, and Dennis Bauknight and Norman Runge (USDA Soil Conservation Service) to the site to discuss soil type and the history of the plantings was made on March 15, 1982.

TECHNICAL INFORMATION

Insects - Pine tip moths - Rhyacionia spp. R. frustrana (Comst.), R. rigidana (Fern.)(figure 2).

Host - Loblolly pine - Pinus taeda (L.)

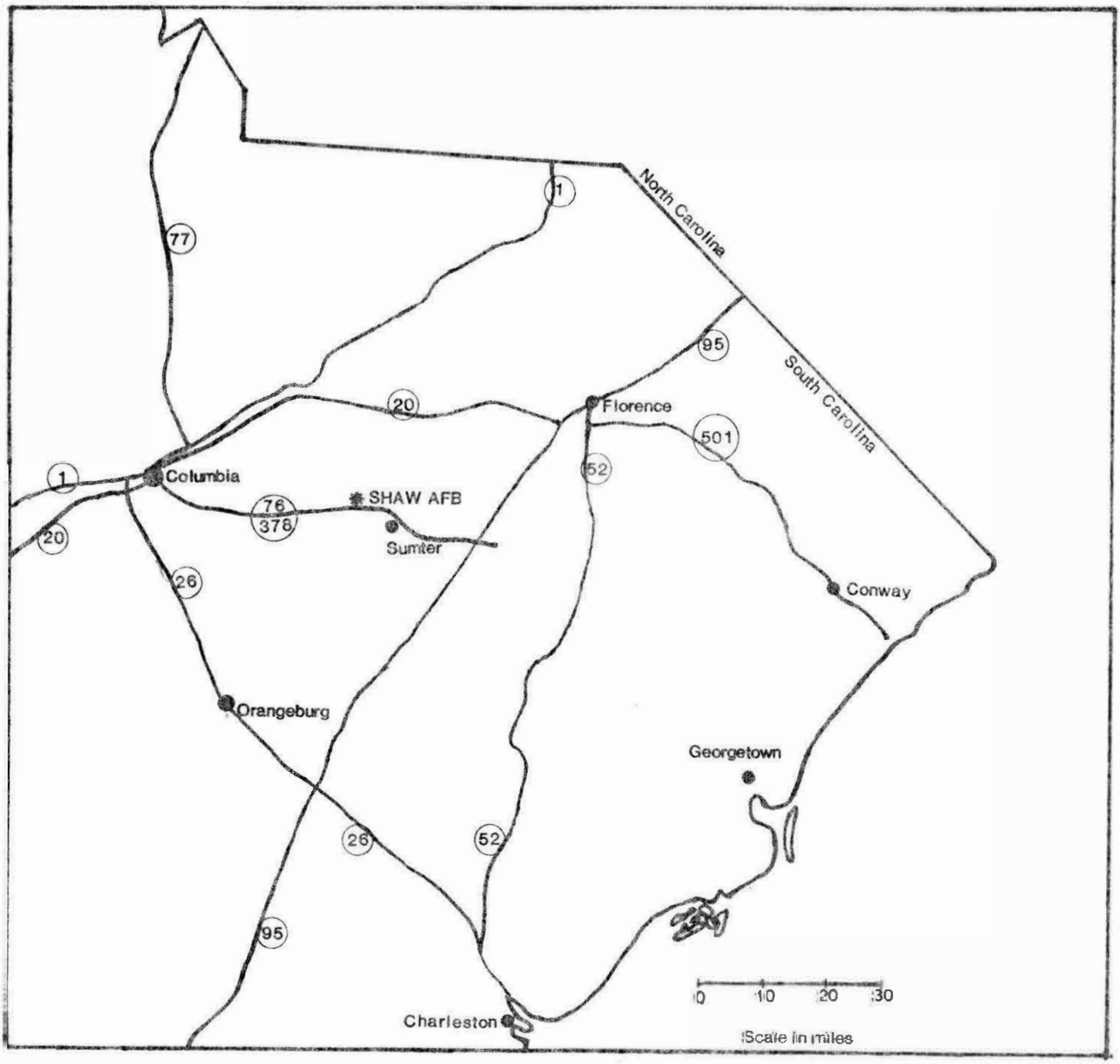

Figure 1. Location of Shaw Air Force Base

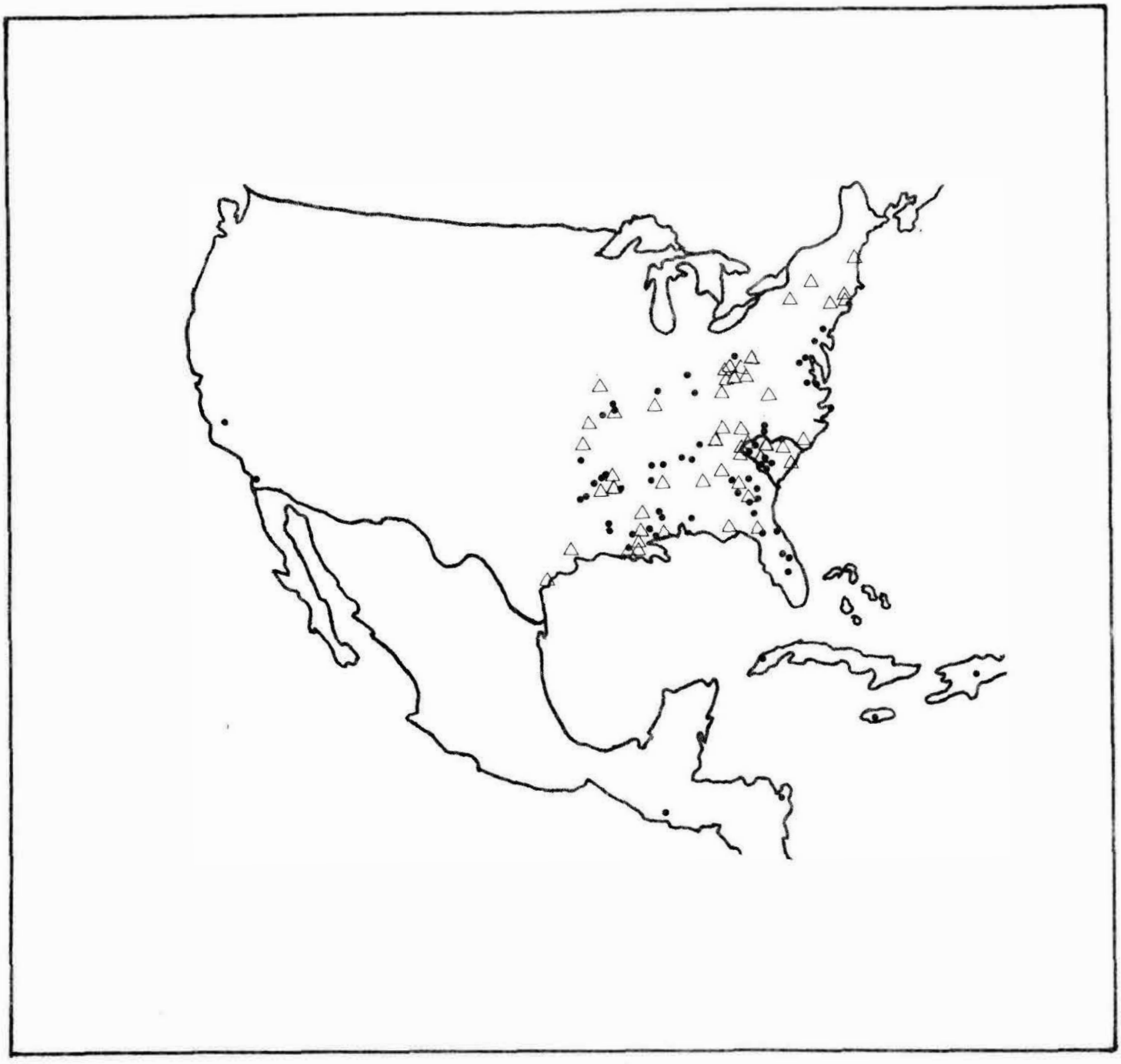

Figure 2. Distribution records for Rhyacionia frustrana (circles) and Rhyacionia rigidana (triangles). (From Powell and Miller, 1978).

Type of Damage

Tree injury is caused by the destruction of buds and shoots by the boring of the tip moth larvae. When the terminal buds or shoots are killed, nearby uninjured buds become the new leaders resulting in crooked and multiple stems. Loss of height growth amounting to .5'-2.5' per year results from this damage.

Insect Life History

These insects overwinter as pupae in the tips of infested pines. In the South, adults emerge during warm days in late winter or early spring. After mating, the females deposit eggs in the axils between the needles and the stem near the terminal buds. After hatching, the larvae bore first into the base of developing needles, and later into the new terminal growth or buds. There may be two to four generations of these insects per year.

RESULTS AND DISCUSSION

Within the plantation, are areas of trees that show the effects of repeated infestation by tip moths. Stunted foliage, bushy appearance of the trees, lack of height growth, as well as the presence of numerous dead terminals are indicative of chronic tip moth infestation. Based on the number of adult tip moths observed during our visits, high population levels of these insects continue to thrive throughout the plantation. Not all of the trees in the plantation show the same degree of injury, but all the trees have been attacked. In general, the trees which have been planted most recently exhibit more damage from tip moth infestations than the older trees.

Superficially, the tip moth infestation would appear to be primarily responsible for the current conditions in the plantation. At least three other factors have adversely affected the trees in the plantation; (1) past agricultural use of the area, (2) poor planting techniques, (3) droughty conditions, and (4) off site planting of loblolly pine. The interaction of these factors has significantly decreased tree vigor which allows the tip moths to maintain a constant population.

Areas that have past history of intensive cultivation for agricultural crops are notorious for being nutrient deficient. Year after year production of row crops may totally deplete the nutrients necessary to support long term tree growth. Annual row crops, unlike perennial forest crops can be grown on these areas because agricultural management employs intense fertilization schedules. In many cases the soil provides only a substrate to anchor the crop. The fertilizer provides the necessary nutrients to support the vegetative growth. When agricultural management and fertilization cease, the soil is essentially barren, incapable of supporting quality vegetative growth. The chlorotic (yellow) coloration of the tree foliage in many areas of the 550 acres indicate that necessary nutrients are lacking.

Evidence of poor planting techniques are abundant throughout the plantation. From our observations, the two most apparent planting errors were insufficient planting depth and planting the seedlings too densely. In the areas where the

physical appearance of the seedlings (stunted vegetation, chlorotic coloration, bushy branching, multiple stems, etc.) is the worst, we extracted numerous seedlings. In each case the main root extended into the soil about 4" and then ran parallel to the soil surface. It appeared that the roots were either inadequately root pruned before planting or that the planting shoe was not set deep enough to allow the planter to set the roots vertically in the soil. In either case, the entire root system lies within a few inches of the soil surface and when droughty conditions occur in areas of sandy soils there is little moisture available to the seedlings. The spacing of seedlings is also a problem and varies from area to area within the plantation. Along some rows the normal 6' distance between seedlings has been reduced to 4' or even 2'. The result is an increase in competition for water and nutrients and the greater density (more trees per acre) provides more host material for the tip moths to infest.

Drought conditions have contributed to the impact of the tip moths on the trees. Anytime that drought conditions exist immediately after planting, seedling growth loss and mortality occur at a higher level. Unfortunately, there is nothing that can be done to predict or alleviate this problem. Reduced seedling vigor and seedlings under stress are conditions that cause the impact of tip moth infestation to be severe.

The factor that we consider to be most important in contributing to the impact of the tip moth infestation is the planting of loblolly pine on this site. Loblolly pine grows best in soils with poor surface drainage, a deep surface layer, and a firm subsoil (Gaiser, 1950 & Zahner, 1954). Information obtained from USDA Soil Conservation Service indicates that the predominant soil series present in the plantation are Kershaw and Lakeland[1/]. It should be noted that so called "man-made" soils are also present due to levelling and filling operations of the past.

Kershaw series soils are nearly level to strongly sloping, deep, loose, excessively drained sand, low in organic matter content, and low in available water capacity. Lakeland series soils' characteristics are very similar to those of the Kershaw series. Both series represent extremely droughty soils requiring large amounts of fertilizer and organic matter to effectively grow crops. Forest crop productivity is rated low for Lakeland and moderate for Kershaw series soils (USDA, 1974). Pine species suitable for planting on these soils are longleaf, and slash pine as recommended by the Soil Conservation Service (USDA, 1974).

Planting of tree species off site invariably results in increased risks of damage from insects, diseases, weather, and general decline of tree vigor, growth, and yield (May, 1965). The damage caused by these factors

1/ Information obtained from a soils map of Shaw Air Force Base assembled by USDA Soil Conservation Service personnel.

may be apparent soon after planting (tip moth infestations) or may not appear until later in the rotation age of the plantation (fusiform rust, annosus root rot, Ips bark beetles, etc.) No matter when the problem manifests, the results are the same; loss of growth, increased tree mortality, loss of yield. While some of the trees in the current plantation may outgrow their susceptibility to attack by tip moths, other problems will no doubt become evident throughout the life of the plantation.

Based on the condition of the plantation today and our concerns for future impacts by other biotic and abiotic factors, this plantation will never produce anything other than a low yield pulpwood crop. However, the first three objectives in establishing the plantation initially may be realized. It is doubtful that all the trees will die or even a majority of them. We anticipate that the trees will continue to grow but very slowly. In areas affected by poor planting techniques, severe drought and intense tip moth infestation, poor tree survival will result in uneven and possibly unsatisfactory stocking levels. To maximize the productive potential of the existing plantation, frequent and expensive maintenance (fertilization, thinnings, replantings, and protection from insects and diseases) would be needed.

OPTIONS

The following options are presented based on the management objectives for the plantation, the present and expected future conditions in the plantation and the economics involved in remedial actions.

1. No action - The present tip moth infestations and contributing impacts would be allowed to continue until brought under control by natural factors (parasites, predators, weather), or decreased susceptibility to attack as the trees increase in height growth above 15'.

Advantages
a. no direct costs involved.
b. the possibility of fulfilling the first three objectives for this plantation might be realized.

Disadvantages
a. increased loss of growth.
b. increased loss of yield.
c. increased seedling mortality.
d. decreased revenues from the plantation at the end of the rotation.
e. potential loss of aesthetic value.

2. Tip Moth Control - Insecticides would be used to control the tip moth infestation until the trees had outgrown their susceptibility to attack.

Advantages
a. increased seedling growth.
b. increased yield.
c. increased revenues at the time of harvest.
d. increased aesthetic value.

Disadvantages

a. insecticide applications provide only temporary solutions to insect problems.
b. insecticides are expensive to purchase and apply.
c. the increased growth, yield, and revenues would not cover the costs of insecticide purchase and application.
d. potential environmental and human hazards if insecticides are handled or applied improperly.
e. insecticide applications would not solve the basic problems in the plantation.

3. Intensive Management - Intensive management of the existing plantation through fertilization, protection, and stand maintenance could lessen the expected losses.

Advantages

a. increased growth.
b. increased yield.
c. increased aesthetic value.

Disadvantages

a. high costs of engaging in a successful intensive management program.
b. inability to recover the investment at the end of the rotation.

4. Conversion of the plantation - By converting the plantation to a pine species (longleaf, slash, sand) more suited to the site, all of the management objectives could be accomplished.

Advantages

a. elimination of the conditions that currently exist in the loblolly plantation.
b. production of a crop of economic value at the end of the rotation.
c. fulfillment of all of the management objectives.

Disadvantages

a. loss of the existing plantation in terms of the management objectives currently satisfied.
b. possible failure of the new plantation because of unexpected biotic and abiotic factors.
c. extremely high costs of removing the present plantation and establishing a new one.

5. Minimum conversion and management - By converting small areas where seedling survival and growth have been poor and by using a minimum amount of management practices, all of the management objectives for the plantation could be accomplished.

Advantages

a. improvement of plantation appearance.
b. increased growth.
c. increased yield.
d. increased revenue at the end of the rotation.
e. maintenance of management objectives already accomplished.

Disadvantages

a. cost of converting to an alternate species.
b. cost of the management practices that would be necessary to maintain converted areas as well as the areas that would remain in loblolly pine.

The situation is complex and difficult to resolve. Any forest crop represents a long term investment. We have presented the facts and believe that a more suitable pine species could accomplish all of the management objectives with time. However, conversion to a different species would not necessarily guarantee success, because of unpredictable biotic and abiotic factors. Economics are an important consideration when considering the options. The "No action" option is the cheapest in terms of monetary outlay, but the "Minimum conversion and management" option may be the best when all factors are considered. We recommend that no additional acreage of loblolly pine be planted on these kinds of soils. However, if you wish to compare seedling survival, growth, and yield between species, small areas of different pine species could be tested. If such a comparison is conducted proper planting and maintenance techniques should be used to provide an unbiased test.

ACKNOWLEDGEMENT

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